RESEARCH NOTES AND STATISTICS

Public-Sector Agricultural Extension in India: A Note

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The importance of agricultural extension in transferring relevant knowledge and information to farmers as well as in translating policy directions into action is well known. India has a long tradition of agricultural extension. Agricultural extension in the post-Independence era was largely the function of State Departments of Agriculture. Some voluntary organisations were also involved in agricultural development activities in different parts of the country, but with limited outreach. The Indian Council of Agricultural Research (ICAR) began its participation in agricultural extension through National Demonstrations in 1964.

A major change in public sector extension came with the implementation of the World Bank sponsored Training and Visit System (T&V) in 1974. Most States adopted the T&V system during the 1980s, and this improved the financial and human resource capacity of the extension system. The 1970s also witnessed the launch of Krishi Vigyan Kendras (KVKs) or Farm Science Centres, Lab-to-Land programmes, and Operational Research Programmes by the ICAR. Krishi Vigyan Kendras (KVKs) were begun by ICAR to provide need-based and skill-oriented vocational training to farmers, field-level extension workers and other self-employed persons. KVKs were meant to bridge the gap between technology developed at research institutions and its adoption at the field level. Their role was to feed proven technologies to the main extension system. The KVK programme began in 1974. There are now a total of 642 KVKs in the country – 429 under State Agricultural Universities (SAUs) and Central Agricultural Universities (CAU), 56 under ICAR institutes, 100 under Non-Government Organisations (NGOs), 35 under State Governments, three under various Public Sector Undertakings (PSUs), and the remaining 18 under other educational institutions. KVKs work under the administrative control of Zonal Project Directorates (ZPDs). There are 8 ZPDs in the country. In 1992, National Demonstrations, Operational Research Projects, and the Lab-to-Land Programme

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were merged with KVKs, and front-line demonstrations and on-farm testing were added to the responsibilities of KVKs. From 2009 onwards, KVKs have also assumed the role of Knowledge and Resource centres in the concerned districts. Each KVK has scientific manpower of six to seven subject-matter specialists.

Low manpower resources restrict the reach of KVKs to a limited number of farmers. Many KVKs are constrained by financial, infrastructural, and human resource limitations and unable to reach the farming community of a district.

Agricultural extension witnessed a qualitative change in the 1990s, with a new focus on privatisation and the withdrawal of support to the state-led extension system. Reduced spending by government weakened the public sector extension system. Other non-governmental agencies stepped in to fill the vacuum.

Facing criticisms on the failure of extension, the government introduced the Agricultural Technology Management Agency (ATMA). The ATMA model was pilot-tested from 1998 to 2005 in 28 districts, and later extended to all 548 rural districts in the country. The ATMA model was meant to make the extension system a demand-driven, market-oriented, and farmer-accountable system. At the district level, ATMA was to function as a registered society of all major stakeholders in agriculture and allied activities, with the objective of becoming a platform for the convergence of the various agencies involved in extension in a district. ATMA was to be the nodal point at the district level for technology dissemination, integrating research and extension activities, and decentralising day-to-day management of the public agricultural extension system. Field-level activities are coordinated through Farm Information and Advisory Centres (FIAC) at the block level. Another feature of ATMA is that it deals with groups such as farmer groups or self-help groups rather than with individuals for the delivery of extension services. It also has provisions for public-private partnership in the district. In 2000, ICAR introduced Agricultural Technology Information Centres (ATIC) in selected ICAR institutes and State Agricultural Universities to function as a single window to disseminate technologies developed in the Universities and Institutes.

Many new service providers and institutional arrangements in agricultural extension have emerged over the last two decades. These include private extension agencies, input agencies, agri-business firms, farmers' organisations, producer cooperatives, financial agencies involved in rural credit delivery, and consultancy services (Sulaiman 2012). The establishment of Agri-Clinics and Agri-Business Centres (AC & ABC) Scheme was an explicit move by government to support private sector initiatives in extension. Under the AC and ABC scheme, unemployed farm graduates were provided training for two months each and given access to credit to start their own ventures. Close to 45904 farm graduates were trained between 2002 and 2016 and more than 19402 ventures begun (AC & ABC 2016). The impact of this initiative is yet to be evaluated.

While the Indian extension system is now guided by a variety of models, schemes, and institutions, public sector extension continues to dominate. Though ICAR's extension initiatives have been important to transformations in Indian agriculture, their capacity and reach has always been limited compared to those of first-line extension systems run by State-level departments of agriculture. Further, since agriculture is a State subject, the mode of organisation and operation of public extension systems vary widely across States.

This note deals with some critical gaps and emerging challenges for agricultural extension in India. The note is based on secondary information collected from various sources including the Planning Commission, the Department of Agriculture and Co-operation, Ministry of Agriculture, Government of India, the Central Groundwater Board, and the National Sample Survey Office (NSSO).

Yield Gap and Access to Information

Among the various functions of extension, the dissemination of information is the most important. Knowledge gaps in turn lead to yield gaps (Morris *et al.* 1998 and Singh *et al.* 2001). Substantial gaps between yields in research stations and actual yields in farmers' fields exist in all principal crops (Table 1). In the case of wheat, for instance, the yield gap was 6 per cent in Punjab and 84 per cent in Madhya Pradesh. In a study of yield gaps in rainfed conditions, Agarwal *et al.* (2008) found substantial yield gaps across all States and in all crops, thus implying large scope for enhancing rainfed crop productivity. On an average, the gap estimated relative to simulated potential yield in rainfed conditions was 2560 kg per hectare for rice, 1120 kg per hectare for cotton, and 860 kg per hectare for mustard.

The Situation Assessment Survey of Farmers 2003 reported that, given a choice, 40 per cent of farmers were willing to leave agriculture. The survey also showed that the coverage of Government extension programmes and extension services of the National Agricultural Research System (NARS) was very low (NSSO 2005). Only 40 per cent of farmers had access to any source of information on modern

Table 1 *Yield gaps for selected crops, States of India, 2007* in per cent

Crop	Yield Gap (range)
Wheat	6 (Punjab) to 84 (Madhya Pradesh)
Rice	Over 100 in Assam, Bihar, Chhattisgarh, and Uttar Pradesh
Maize	7 (Gujarat) to 300 (Assam)
Sorghum	13 (Madhya Pradesh) to 200 (Karnataka)
Mustard	5 (Haryana) to 150 (Chhattisgarh)
Soybean	7 (Rajasthan) to 185 (Karnataka)
Sugarcane	16 (Andhra Pradesh) to 167 (Madhya Pradesh)

Source: Planning Commission (2007)

technology. Of those who had access to such information, the highest proportion obtained information from other progressive farmers (16.7 per cent), followed by input dealers (13.1 per cent), and radio broadcasts (13 per cent). Only 5.7 per cent of farmers had received information from extension agents. Further, the major problem reported by those who had access to extension services was the practical relevance of the advice. The Situation Assessment Survey 2013, though not strictly comparable, again highlighted the prominence of farmer-to-farmer exchange of information in Indian agriculture. Traditional and modern ICTs (newspapers, radio, television, and internet) have also assumed an important role as a source of information for farmers. At the all-India level, 41 percent of cultivating households accessed technical help from any source during the reference period (July-December 2012). Public extension agencies, including extension workers, KVKs, and State Agricultural Universities, were a source of information for around 10 per cent of households (NSSO 2014).

A study in Maharashtra by Bachhav (2012) concluded that the majority of farmers seek information on availability of seeds (74 per cent), crop production (71 per cent), fertilizer (65 per cent) and insecticide availability (62 per cent). Other areas mentioned by farmers were water management (34 per cent), weather information (23 per cent), and agricultural equipment (18 per cent). Similar findings were observed by Meitei and Devi (2009), who concluded from a study in Manipur State that most farmers seek information on crop production and availability of seeds and fertilizers. Babu *et al.* (2012) observed that the most important information needs for rice farmers in Tamil Nadu related to disease and pest management, and pesticide and fertilizer application. The most important information need of tribal farmers, as identified by Saravanan (2007), concerned disease and pest management, followed by information related to suitable crop varieties, packages of practices, farmers' training programmes, irrigation, and farm credit.

A recent study by Reardon *et al.* (2011) in Uttar Pradesh showed that public sector extension sources (State extension staff, KVKs, All-India Radio, university extension, and plant protection units) were collectively a source of information for only 25 per cent of farmers. In Madhya Pradesh, 37 per cent of the farmers had contacted State extension staff (Reardon *et al.* 2011) for services. Other major sources of extension services for farmers in Madhya Pradesh were All-India Radio and television (21 per cent), and KVKs (12 per cent). Private sector sources accounted for 25 per cent of all information sources.

Glendenning *et al.* (2010) concluded from a review of agricultural extension in India that despite the variety of agricultural extension approaches that operate in parallel and sometimes duplicate one another (see Figure 1), the majority of farmers in India do not have access to any source of information; this lack of access severely limited their ability to increase productivity and income and reduce vulnerability.

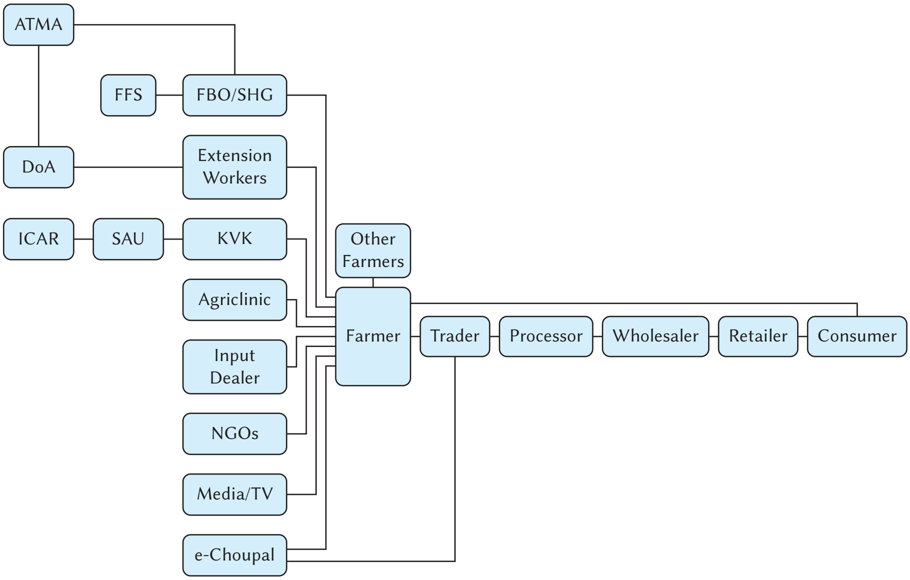

Figure 1 *Information flow from agricultural extension agencies in India*
Notes: Information flow is the line between the boxes; strength and feedback in each line are not described here. ATMA=Agricultural Technology Management Agency, DoA=Department of Agriculture, ICAR=Indian Council for Agricultural Research, FFS=farmer field school, FBO/SHG=farmer-based organisation/self-help group, SAU=State Agricultural University, KVK=Krishi Vigyan Kendra (farm science centre), NGO=non-governmental organisation.
Source: Glendenning *et al.* 2010.

Public-private partnerships, hailed as a major means of harnessing the strengths of both public and private actors, are still at a nascent stage in agricultural extension. Madhya Pradesh is the only State in India where public-private partnership in agriculture was initiated in the form of collaboration between the State department of agriculture and the Dhanuka group of companies, a group with a strong base in agrochemicals. Partnership was envisaged in areas such as soil testing, training, transfer of technology through cyber-cafes, establishment of markets, and provision of credit facilities. An impact assessment of the programme showed that there was an increase in the productivity of four major crops, namely rice, wheat, pigeon pea (*arhar*), and chickpea (*gram*), which in turn was reflected in higher incomes for farmers (Chandra Shekhara *et al.* 2010). The sustainability of such partnerships, however, has not been established.

Inclusiveness and Extension

Another concern facing Indian agriculture is the proliferation of smallholders who operate two hectares or less. Smallholders now cultivate 44 per cent of operated land and small holdings constitute 85 per cent of all operational holdings. Owing to the increase in population and consequent fragmentation of land, the average size of land holding has decreased over time. The average size of holdings for all operational classes declined from 2.82 hectares in 1970-1 to 1.16 hectares in 2010-1 (DAC 2013). The share of smallholders in total production has increased in the case of food grain, oilseeds, sugarcane, fruit and vegetables. The cost of cultivation per hectare is higher on small and marginal farms than medium and large farms (Dev 2012). Small farms are often unable to generate adequate incomes and hence smallholders are vulnerable to various risks. Globalisation and trade liberalisation add to the worries of small farmers, who are compelled to compete on quality and prices in the export and domestic markets, and often find it difficult, owing to limited financial resources, to cope with the specifications of a new market regime.

Data from the Situation Assessment Surveys of the NSSO bring out variations in access to information across farmers of different land size categories.[1] In 2003, the proportion of farmers that gained access to information from any source was 54, 51 and 38 per cent in the case of large, medium and small farmers respectively. The proportion of farmers with access to information was found to increase with an increase in the size of holding. Smallholder farmers were found to rely mainly on local sources of information, such as progressive farmers (16 per cent) and input dealers (12.6 per cent), along with the radio (12.4 per cent). In case of medium-size and large farmers, the major sources of information in addition to those above were television (15.3 and 22.4 per cent), newspapers (10.3 and 15.9 per cent) and extension agents (9.8 and 12.4 per cent). To put it differently, only 4.8 per cent of smallholders viewed the extension worker as a primary source of information, as compared to 9.8 per cent of medium farmers and 12.4 per cent of large farmers (Adhiguru *et al.* 2009).

These observations have serious implications for organising the extension system in India, where 83 percent of farmers meet their livelihoods from small and marginal land holdings. It is well acknowledged that smallholders' vital contribution to India's food and agricultural economy and national food security depends on their responsiveness to public policies and to national investments in agricultural research and development and public infrastructure (Singh *et al.* 2002). Any decline in public investment in these critical public goods raises concerns for future agricultural growth. So the "elite bias" in access to information can seriously impede the growth of agriculture in future. Given the skewed nature of distribution of advanced electronic assets in favour of resource-rich farmers, personal contacts provided by extension workers carry greater weight in achieving extension objectives among small farmers.

Another dimension of exclusion of extension support is with regard to disadvantaged regions, crops, and sections of society. These include, among others, non-timber forest produce in tribal areas, dry land crops, and small ruminants (sheep and goat). In remote and disadvantaged areas, farmers are rarely contacted by extension agents.

[1] Disaggregated results from the 2013 survey are not yet available.

Specialised and client-oriented extension approaches that focus on livelihoods rather than technology dissemination are needed for such areas (Sulaiman 2003).

The Challenge of Achieving Convergence

The scope of extension is increasingly becoming wider, covering all aspects of farming, from seeds to market. Farmers need information not only on best practices and technologies for crop production, but also information about post-harvest tasks including processing, marketing, storage, and handling (Van den Ban 1998, Sulaiman and Holt 2002). Given the diversity of Indian agriculture, attempting a single blueprint for an extension strategy for smallholders is futile. What is ideal in a particular context depends entirely on the initial conditions in that particular context. A "best fit" approach, as proposed by Birner *et al.* (2006), will be more relevant and that requires mobilisation of farmers and networking with different stakeholders in the agricultural innovation system, such as research institutions, input dealers, processors, buyers, and financial agencies.

The establishment of the Agricultural Technology Management Agency (ATMA) was a major step forward in the convergence of multiple actors engaged in agricultural extension. ATMA is supposed to act as an umbrella organisation for all major stakeholders in agriculture and allied activities within a district. The Strategic Research and Extension Plan (SREP) is an important feature of ATMA. It is to be formulated by identifying local research and extension priorities in consultation with farmers. At the ground level, farmers' groups act as platforms for the convergence of various advisory and service providers. ATMA also tried to utilise the potential of agri-entrepreneurs, custom hire service providers, input dealers, and extension workers in non-governmental organisations to supplement the efforts of public extension functionaries (DAC 2014). The Modified Extension Reforms Scheme introduced in 2010 was intended to synergise interventions under various schemes under the umbrella of ATMA. The initiation of a National Mission on Agricultural Extension and Technology (NMAET) in 2014, with four sub-Missions on agricultural extension, seed and planting material, agricultural mechanisation, and plant protection and plant quarantine, is envisaged as a further step in this direction. The aim of the Mission is to restructure and strengthen agricultural extension to enable the delivery of appropriate technology and improved agronomic practices to farmers by a combination of extensive physical outreach and interactive methods of information dissemination (DAC 2014).

Other than ATMA, there are some smaller interventions to promote convergence. Notable examples include "Convergence of Agricultural Interventions in Maharashtra's Distress Prone District Scheme" (Vidarbha region) and "Rural Bio-Resource Complex Project" in Bangalore Rural district implemented by the University of Agricultural Sciences, Bangalore, since April 2005. The latter project was implemented in Doddaballapura taluk of Bangalore Rural district, and claimed to cover 8340 families spread over 75 villages in five panchayats in a contiguous area. Major features of the project included the identification of the most profitable, sustainable and location-specific technologies, timely and dependable information within easy reach of rural people, providing critical inputs free of cost, effective functional linkage, marketing empowerment, and commodity-based associations (Gowda 2009). The sustainability of such initiatives, especially after the withdrawal of the implementing agency, requires that appropriate institutions be created at the ground level.

Natural Resource Orientation in Agricultural Extension

The depletion and degradation of natural resources is an important challenge confronting the long-term sustainability of Indian agriculture. Non-judicious use of inputs – fertilizer and water, in particular – is emerging as a major concern in the wake of the degradation of natural resources and consequent reduction in resource productivity. Indiscriminate use of chemical fertilizers is a major cause of soil degradation and groundwater pollution.

One problem is that the recommended N: P: K ratio (4:2:1) is not followed and there is an imbalanced use of fertilizers, especially of nitrogenous fertilizers.[2] Price policy with respect to fertilizers has a large role to play here, as use is related to the decontrol of prices of certain fertilizers. Nevertheless, the need for providing awareness on nutrient applications based on soil fertility analysis cannot be underemphasised. Table 2 shows that although the imbalance in fertilizer use decreased between 1996-7 and 2006-7, it is still large.

Secondly, there is large non-uniformity in fertilizer consumption across States (DAC 2013). Per hectare consumption was as high as 244 kg in Punjab and 266 kg in Andhra Pradesh, and as low as 5 kg in some of the North Eastern States. Madhya Pradesh (88 kg per hectare), Odisha (57 kg per hectare), Rajasthan (62 kg per hectare) and Himachal Pradesh (55 kg per hectare) were characterised by medium levels of fertilizer use. These imbalances too need to be rectified with immediate effect to ensure efficient nutrient application, which in turn can lead to an increase in production and a decrease in costs of production. Extension, ideally, should have a programme on soil health.

In the case of irrigation, over-exploitation of groundwater and consequent decline in groundwater table is well documented. Table 3 reveals the critical situation in terms of shrinking water resources in the country. Out of 5842 assessed administrative units (Blocks/taluks/mandals/districts), groundwater was overexploited in 802 units, critical in 169 units, and semi-critical in 523 units (DAC 2013). Some of the critical

[2] The ideal ratio of Nitrogen (N), Phosphorus (P) and Potassium (K) nutrient of 4:2:1 is an approximated value aggregated at the all-India level. Though individual values diverge across regions and crops, on a broad basis, for a large contiguous area, this value is widely followed.

Table 2 *Trends in fertilizer application and nutrient imbalance, by farmer category, 1996-7 and 2006-7* in kilograms per hectare

Farmer category	Nutrients (kg per hectare)			Nutrient ratios	
	N	P	K	N:K	P:K
2006-7					
Marginal	86.2	36.4	17.1	5.1	2.1
Small	76.6	35.9	15.8	4.8	2.3
Semi-medium	67.8	30.0	10.5	6.4	2.9
Medium	61.6	26.6	7.0	8.8	3.8
Large	45.3	19.0	3.4	13.4	5.6
Overall	70.3	30.9	11.6	6.0	2.6
1996-7					
Marginal	64.8	27.7	11.3	5.7	2.4
Small	49.9	23.8	8.9	5.6	2.7
Semi-medium	46.8	22.2	6.4	7.4	3.5
Medium	44.0	20.3	3.9	11.3	5.2
Large	34.1	15.4	1.6	21.5	9.7
Overall	48.4	22.2	6.5	7.4	3.4

Source: Computed by the authors using Input Survey (1996-7 and 2006-7), Department of Agriculture and Co-operation, Government of India.

areas were in Rajasthan, Haryana, Punjab, western Uttar Pradesh, western Andhra Pradesh, and North Western Tamil Nadu. Unsustained groundwater exploitation will be a serious threat even to the availability of drinking water in the near future.

Presently, the agricultural sector is using about 83 per cent of available water resources (DAC 2013). There is an immediate need to adopt groundwater-replenishing activities

Table 3 *Status of categorisation of talukas/blocks/mandals with respect to groundwater extraction, selected States, 2009* in per cent of total blocks assessed

State	Semi-critical	Critical	Over-exploited	All
Andhra Pradesh	8.4	2.3	7.6	18.3
Gujarat	9.0	2.7	12.1	23.8
Haryana	7.8	18.1	58.6	84.5
Karnataka	12.6	4.1	26.3	43.0
Madhya Pradesh	19.5	1.3	7.7	28.5
Maharashtra	5.4	0.3	2.5	8.2
Punjab	1.4	2.2	79.7	83.3
Rajasthan	6.7	10.5	69.5	86.7
Tamil Nadu	17.4	8.5	36.0	61.9
Uttar Pradesh	13.0	3.9	9.3	26.2

Note: Talukas/blocks/mandals are administrative units at sub-district level.
Source: Computed by the authors from data from the Central Groundwater Board (2011).

and less water-intensive farming methods like sustainable crop intensification and conservation agriculture. The adoption of such practices is a function of many factors, but agricultural extension has a role to play. There is a need to initiate specialised water-focused extension approaches, particularly in water-scarce regions. Such an approach would need to cover critical areas of soil and water conservation, rainwater harvesting, increased water use efficiency, and the conjunctive use of ground and surface water. Currently, water use efficiency is largely undertaken as a private initiative to promote drip and sprinkler irrigation. Water conservation efforts like rainwater harvesting are being run as routine schemes of the government. In canal-irrigated regions, the task is to increase water-use efficiency and share water resources. These interventions require joint efforts by various departments of the Government that have a stake in rural development, including departments of agriculture, rural development, irrigation, power, water, and forestry in different States.

Human and Financial Resources in India's Extension

The departments of agriculture of State governments are still the main agricultural extension agencies in India in terms of number of personnel and geographical coverage. India has a total of 0.12 million agricultural extension workers to serve a net cropped area of 141 million hectares and 158 million operational holdings. Table 4 provides information on the extent of net cropped area and operational holdings covered per extension worker in selected States of India. There is large variation in the intensity of personnel per acre and holding across States. In 2012, the number of operational holdings covered by an extension person varied from 249 in Jammu & Kashmir to 3162 in Andhra Pradesh. Similarly, an extension person was required to cover a net cropped area of as much as 3194 hectares in Rajasthan and 2982 hectares in Punjab.

The number of extension personnel in India is, however, only one-sixth of that in China. With this meagre number of extension personnel, serving widely dispersed farmers with diversified information needs is a really hard task. Moreover, most of the extension personnel are overburdened with multiple roles. Though farmers need information on the entire food and agriculture value chain, starting from forecasts of weather conditions to market prices of the produce, the public extension system largely concentrates on on-farm activities (Glendenning *et al.* 2010).

To overcome the paucity of human resources, the Department of Agriculture and Cooperation (DAC) of the Government of India opened Kisan Call Centres in January 2004.The intention was to use the potential of information and communication technology to respond to farmers' queries and concerns in local languages. A farmer could contact the call centre in his/her State (open from 6 am to 10 pm) by dialing a toll free number and seek answers to his/her problems. Agricultural graduates posted at the call centre were to provide the answers, and if unable to address the problem, would forward the query to experts at the next level.

Table 4 *Extension intensity or the number of extension personnel per operational holding and net cropped area, selected States* in number and hectares

States	Number of extension personnel	Number of operational holdings/extension personnel	Net cropped area/extension personnel (in hectares)
Andhra Pradesh	4167	3162	2608
Assam	2779	979	991
Bihar	10231	1583	553
Chhattisgarh	4313	869	1092
Gujarat	3501	1353	2799
Himachal Pradesh	1084	886	499
Haryana	3019	536	1184
Jammu and Kashmir	5812	249	127
Jharkhand	4129	656	364
Karnataka	3226	2428	3154
Kerala	3933	1737	531
Madhya Pradesh	10775	823	1387
Maharashtra	15770	869	1105
Orissa	3794	1230	1477
Punjab	1398	753	2982
Rajasthan	5495	1254	3194
Tamil Nadu	8320	976	606
Uttar Pradesh	12976	1767	1265
Uttarakhand	1031	885	731
West Bengal	6164	1156	859
All India	119048	1156	1187

Notes: The data on number of operational holdings, net cropped area, and numbers of extension personnel correspond to the years 2006, 2008, and 2012 respectively.
Source: Computed by the authors using information on human resources from the Desk Survey of the Department of Agriculture and Co-operation and the Agricultural Census, 2007.

There are currently 25 call centres located in different parts of the country covering all the States and Union Territories. Sharma *et al.* (2011) have observed that KCCs are effective in hill agriculture where extension outreach is difficult.

Trends in expenditure (Centre plus State governments) on extension by subsector of agriculture (crop, livestock, and fisheries) from 1972-3 to 2010-1 are shown in Figure 2. The graph shows that the steady rise in expenditure on extension was reversed in the early 1990s, and began recovering only after 2004-5.

Between 1995-6 and 2004-5, real extension expenditure declined in the case of crops and soil and water conservation activities, resulting in a decline in total expenditure. The livestock and fisheries sectors witnessed a higher rate of growth, but that could be attributed to lower base values (Table 5). However, there was a spurt in growth of

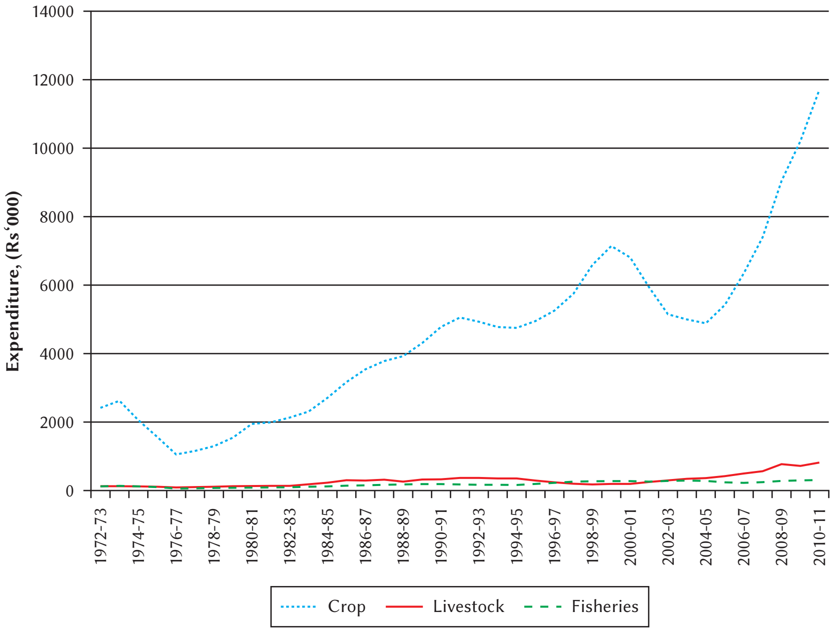

Figure 2 *Trend in extension expenditure in India, 1972-3 to 2010-1, real price (in constant 2004-5 prices)*

Note: Extension expenditure here denotes plan funds only.

Source: Computed by the authors based on data from Chand, Kumar, and Kumar (2011b) (1972-3 to 2004-5) and CAG of India (2005-6 to 2010-1).

extension expenditure from 2005-6 to 2010-1 on account of initiatives such as taking Agricultural Technology Management Agencies (ATMA) to all districts.

The livestock sector needs to be accorded high priority as it raises farm incomes and the nutritional security of poor households (Kumar and Mittal 2000). Major challenges facing India's livestock sector include an inadequate number of veterinary hospitals,

Table 5 *Level and growth of extension expenditure in India, by sector, 1972-3 to 2010-1* in million rupees (at 2004-5 prices) and percentage per year

Period	Crop	Livestock	Fisheries	Total
Expenditure (Rs)				
1972-3	2412.99	126.44	117.73	2657.16
1994-5	4747.66	350.37	161.18	5259.21
2004-5	4883.76	362.55	279.71	5526.02
2010-1	11701.23	813.98	307.20	12822.41
Growth rate (percentage per year)				
1972-3 to 1994-5	1.06	1.07	1.04	1.06
1995-6 to 2004-5	-0.84	4.73	3.28	-0.41
2005-6 to 2010-1	16.18	9.98	6.35	15.41

Source: Computed by the authors from data in Chand *et al.* 2011b and CAG of India (2005-6 to 2010-1).

dispensaries, and technical manpower. Extension for livestock has focused on bovines to increase milk production, while neglecting other commodities such as meat, and other animals, such as small ruminants. India is the second largest producer of fish in the world. Fisheries provide livelihood opportunities to millions of people directly and through a number of subsidiary industries. Here too, one of the major constraints is inadequate extension staff for training of fishers and fisheries personnel (DAC 2013). It is also to be noted that the extension needs of inland and marine fisheries are quite different in terms of approaches and scale.

The Way Forward: Policy Implications

Indian agriculture is confronting serious issues such as a huge yield gap, a multitude of smallholders, imbalances with respect to input use and declining natural-resource productivity. Extension systems in India, which have an important role to play in addressing these concerns, are constrained by financial, infrastructural, and human resource limitations. An analysis of extension expenditure showed a serious setback in the 1990s. There is an immediate need to increase investment in extension.

The inclusiveness of extension services remains a major concern. Considering the prevalence of smallholders in Indian agriculture and the complexity of the problems confronting them, suitable extension strategies need to be formulated. The growth of smallholder agriculture will be determined by the extent to which institutions of research and extension are attuned to their priorities.

The focus of agricultural extension has been on increasing yield with much less attention paid to ecosystem health and natural resource conservation. Given the public-good nature of many of the benefits of natural-resource management activities, the role of government is critical.

Lastly, while there are a variety of institutions in the field of extension, the ability of private extension to reach disadvantaged and marginalised areas, enterprises and sections of society is not yet established. While private and non-governmental institutions should be encouraged, public extension has to be strengthened to cater to the scale and diversity of agriculture in India.

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